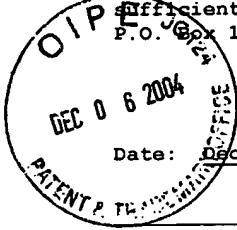


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Date: December 2, 2004

Dennis P. Tramaloni

(Print Name)

(Signature)

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Group No.: 1646

Kleomenis Barlos, et al.

Serial No.: 10/740,207

Filed: December 18, 2003

For: PROCESS FOR REGENERATING 2-CHLOROTRITYL CHLORIDE RESINS

TRANSMITTAL OF CERTIFIED COPY

December 2, 2004

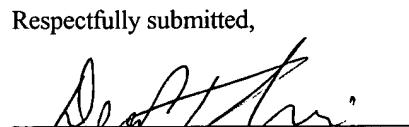
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Dear Sir:

Attached please find the certified copy of the foreign application from which priority is claimed for this case:

<u>Country</u>	<u>Application No.</u>	<u>Filing Date</u>
Europe	02028744.7	December 20, 2002

Respectfully submitted,

  
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Enclosure

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**Bescheinigung**

**Certificate**

**Attestation**

Die angehefteten Unterlagen stimmen mit der ursprünglich eingereichten Fassung der auf dem nächsten Blatt bezeichneten europäischen Patentanmeldung überein.

The attached documents are exact copies of the European patent application described on the following page, as originally filed.

Les documents fixés à cette attestation sont conformes à la version initialement déposée de la demande de brevet européen spécifiée à la page suivante.

**Patentanmeldung Nr.      Patent application No.      Demande de brevet n°**

02028744.7

Der Präsident des Europäischen Patentamts;  
Im Auftrag

For the President of the European Patent Office  
Le Président de l'Office européen des brevets  
p.o.

**R C van Dijk**

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Anmeldung Nr:  
Application no.: 02028744.7  
Demande no:

Anmelddetag:  
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Date de dépôt:

Anmelder/Applicant(s)/Demandeur(s):

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SUISSE

Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:  
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.  
If no title is shown please refer to the description.  
Si aucun titre n'est indiqué se referer à la description.)

Process for the recycling of solid phase bonded 2-chlorotrityl chloride

In Anspruch genommene Priorität(en) / Priority(ies) claimed /Priorité(s)  
revendiquée(s)

Staat/Tag/Aktenzeichen/State/Date/File no./Pays/Date/Numéro de dépôt:

Internationale Patentklassifikation/International Patent Classification/  
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C08F8/00

Am Anmelddetag benannte Vertragstaaten/Contracting states designated at date of  
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AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SI SK

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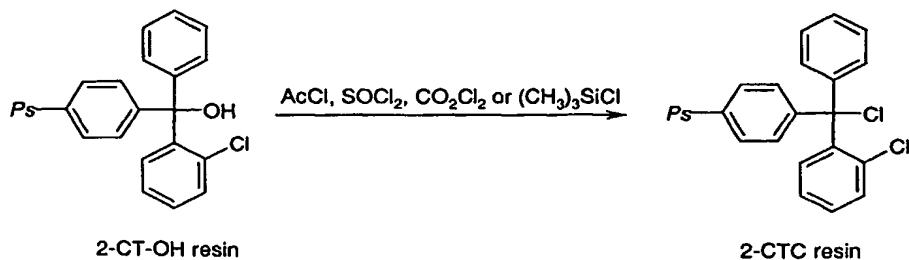
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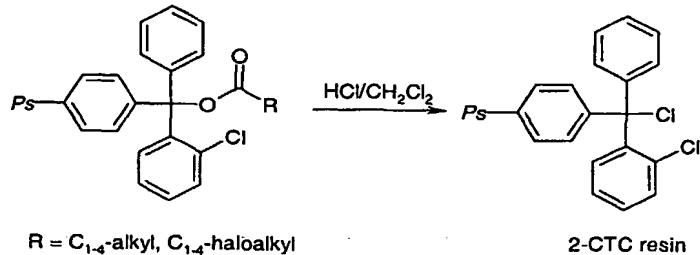
Process for the recycling of solid phase bonded 2-chlorotriyl chloride

Triyl resins are useful solid phase bonded protecting groups, originally developed for solid phase peptide synthesis and as well used for solid phase organic synthesis. Solid phase bonded 2-chlorotriyl chloride (2-CTC resin) is commercial available [CBL Patras] and based on crosslinked polystyrene (Ps) or modified polystyrenes (e. g. tentagel, polystyrene grafted with polyethyleneglycol) [1: catalog ACT, Noviabiochem]. The 2-CTC linker is an acid labile resin and because of its excellence properties playing a significant role in novel linker technology [2: THL 1997, 6347, 2629; Int. J. Pep. Prot. Res. 37 (1991) 513]. Cleavage of peptides from 2-CTC resin can be effected by treatment under very mild acidic conditions (e. g. dilute TFA/DCM, AcOH/DCM, HFIP) [1, 3: Liebigs A. 1988, 1079, THL 1997, 7299]. Despite being an expensive [1] and a valuable synthetic tool, a simple, efficient, gentle, reproducible experimental description for the recycling of - in solid phase synthesis - "used 2-CTC resin" without any loss of activity is so far unknown in the literature.

To synthesize 2-CTC resin from the 2-chlorotriphenylcarbinol resin (2-CT-OH resin), references are given to the experimental procedure of the parent tritylchloride resin from the triphenylmethanol resin in an analogous manner [4: THL 1989, 3943; Can. J. Chem. 54 (1976) 926] or more detailed [1, 5: THL 1998, 3241; 6: React. Funct. Polym. 41 (1999) 111].



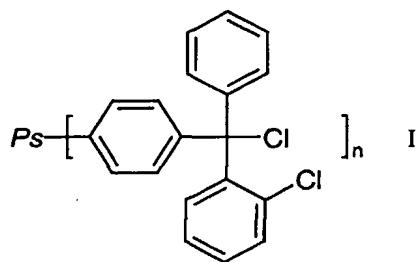
WO 01/85758 A2 [7] discloses the recycling of carboxylic acid (e.g. preferably trifluoroacetic acid) trityl ester resins with HCl in  $\text{CH}_2\text{Cl}_2$ . Apart of the fact that trifluoroacetic acid trityl esters are subject to hydrolysis [8: Z. Phy. Chem. 113 (1978) 199] and therefore difficult to handle, the reexamination of the example given in [7] achieved 5 only 77% of the content of active chloride [6] before use.



After loading of 2-CTC resin with Fmoc-amino acids, unreacted active sites are end-capped with alcohols, especially methanol and Fmoc protecting groups are deprotected with amines, especially piperidine [1, 9: W. C. Chan, P. D. White in Fmoc Solid Phase 10 Peptide Synthesis] leading to a certain amount of methylether and amine substructures in the resin. These substructures decrease the yield of the recycling step and consequently the activity (content of active chloride) of the recycled resin.

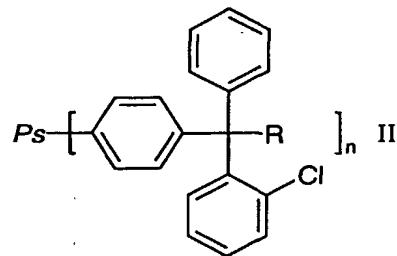
Surprisingly it has now been found, that by carrying out a reaction of used 2-CTC resin (comprising of a compound of formula II) in the presence of a chlorinating agent 15 and an organic solvent, the recovered 2-CTC resin achieved unexpectedly the content of active chloride [6] before use. Further it has been found that above recycling of "used resin" surprisingly took place quantitatively due to conversion of compound of formula II wherein R is as defined below to 2-CTC resin. The recycled 2-CTC resin loaded successful 20 Fmoc-Trp(Boc) or Fmoc-Leu [9: p. 217]. It was found that chlorination with HCl in the presence of an organic solvent is also applicable for the conversion of 2-CT-OH resin to 2-CTC resin.

The present invention describes a process for the preparation of solid phase bonded 2-chlorotriyl chloride (2-CTC resin) of formula I



wherein Ps is a polymeric support and n has the following meaning:  $1 \geq n > 0$

comprising the reaction of solid phase bonded 2-chlorotrityl of formula II



5 wherein R is OH or/and  $OC_{1-4}$ -alkyl or/and  $NR'R''$

wherein R' and R'' independently of each other represent  $C_{1-4}$ -alkyl, or R' and R'' together with the nitrogen to which they are bonded represent a 5 to 8 membered heterocyclic radical

in the presence of a chlorinating agent and an organic solvent.

10 In a further embodiment the reaction is carried out wherein

R is OH,  $OCH_3$ ,  $OC_2H_5$ ,  $OC_3H_7$ , and

R' and R'' independently of each other represent methyl, ethyl, or

R' and R'' together with the nitrogen to which they are bonded represent piperidine

most preferred wherein R is OH or/and  $OCH_3$  or/and piperidine

15 in the presence of HCl and an organic solvent.

The term "polymeric support" within the present invention means polymeric resins suitable for use in solid phase synthesis, or surfaces in which polymers, having synthesis properties similar to these polymeric resins are attached to a solid support, or modified silica gels suitable for use in solid phase synthesis, preferably polystyrene (0-25%

divinylbenzene crosslinked), more preferred 0-10% divinylbenzene crosslinked and most preferred 1% divinylbenzene crosslinked.

The term "solid phase bonded 2-chlorotriyl" within the present invention means 2-chlorotriyl bonded to the polymeric support as defined above.

5 The value "n" within the present invention has the following meaning:  $1 \geq n > 0$ , therefore the value "n" may be between 0 and 1, whereas 1 is included. In a preferred embodiment, the value "n" has the following meaning:  $0.9 \geq n \geq 0.5$ .

10 Within the present invention a compound of formula II wherein R is OH or/and OC<sub>1-4</sub>-alkyl or/and NR'R" wherein R' and R" independently of each other represent C<sub>1-4</sub>-alkyl, or R' and R" together with the nitrogen to which they are bonded represent a 5 to 8 membered heterocyclic radical (preferably wherein R is OH, OCH<sub>3</sub>, OC<sub>2</sub>H<sub>5</sub>, OC<sub>3</sub>H<sub>7</sub>, dimethylamine, diethylamine, methylethylamine or/and piperidine; most preferred wherein R is OH or/and OCH<sub>3</sub> or/and piperidine) is used.

15 The ratio of OH and OC<sub>1-4</sub>-alkyl and NR'R" may be between 100:0:0 and 0:100:0 and 0:0:100. In a preferred embodiment the compound of formula II wherein R is OH is enriched.

Within the present invention 5 to 8 membered heterocyclic radicals for the term NR'R" are the following moieties: pyrrolidinyl, piperidinyl.

20 According to the present invention, "used resin" (formula II), obtained after peptide cleavage [1, 3], e.g. in the case of T-20 or T-1249 [10: US 5,464,933, US 6258782] and quenching with pyridine (traces of water) [11: JACS 80 (1958) 812], was recycled after washing (e.g. dioxane) in the presence of a chlorinating agent and an organic solvent. The carbinol substructure in "used resin" could be verified by IR-spectroscopy ( $\nu_{OH} = 3566$  cm<sup>-1</sup>). Trace amounts of Methanol (evidence of minimum -OCH<sub>3</sub> content in "used resin")

25 could be detected by GC in the filtrate of the recycling experiments and nitrogen content by elemental analysis of "used resin". The recycling reaction may be carried out in organic solvents: e. g. toluene, chlorobenzene, CH<sub>2</sub>Cl<sub>2</sub>, DMSO, NMP (1-methyl-2-pyrrolidinone), DMF, ethers or cyclic ethers with high absorption capacity of HCl gas (such as alkylethers, DME, Diglyme or THF, dioxane). The recycling reaction is preferably carried out in the

30 presence of THF or dioxane, most preferred in the presence of dioxane.

Further, the recycling reaction may be carried out with chlorinating agents known from textbooks about organic chemistry (e.g. from J. March (1992), "Advanced Organic Chemistry: Reactions, Mechanisms, and Structure", 4<sup>th</sup> ed. John Wiley & Sons) such as

PCl<sub>5</sub>, PCl<sub>3</sub>, POCl<sub>3</sub>, SOCl<sub>2</sub>, CH<sub>3</sub>COCl, CO<sub>2</sub>Cl<sub>2</sub>, (CH<sub>3</sub>)<sub>3</sub>SiCl or HCl. Preferred chlorinating agents are PCl<sub>5</sub>, PCl<sub>3</sub>, POCl<sub>3</sub> or HCl, and most preferred chlorinating agent is HCl.

In a further embodiment, the present invention may be carried out in a single percolation or in repetitive percolations.

5 In a preferred embodiment, the process is carried out with excess HCl.

The reaction may be carried out at a temperature between 0°C and 110°C preferably at a temperature between 0-50°C and most preferred at a temperature between 10°C and 25°C.

10 The reaction may be carried out in the organic solvent (preferred dioxane or THF, most preferred dioxane) wherein the HCl content is about 0-10 g/100ml, preferably 10-20 g/100 ml, most preferred > 20 g/100 ml.

The reaction may be carried out for 6-96 h preferably for 17-96 h and most preferred for 21-24 h.

15 Experimental part:

In a double-walled jacket reactor with glass frit bottom 5 g pure "used resin" (formula II) was - optionally after pretreatment in the organic solvent (table 1) and suction of the solvent - stirred slowly in the organic solvent (table 1) with dissolved chlorinating agent (table 1) at specified reaction temperature (T: table 1) for specified 20 reaction time (t: table 1). After completion of the percolation and suction of the reaction solution the remaining resin was washed with the reaction solvent, treated with hexane and dried under vacuum at 35°C. The content of active chloride (table 1) of the recycled 2-CTC resin (formula I) was determined [6] and its content of nitrogen by elemental analysis was below detection limit. The virgin 2-CTC resin (formula I) had content of 25 active chloride before use: ~1.27 mol/kg. The "used resin" (formula II) had no active chloride before use [6] and the content of compound of formula II wherein R is OC<sub>1-4</sub>-alkyl is lower 5% but higher 0%, and the content of nitrogen is lower 0.2% but higher 0%.

Table 1:

formular II R is	solvent	chlorinating agent	T [°C]	t [h]	content of active chloride [mol/kg]
OH, OCH <sub>3</sub> , piperidine	80 ml toluene	10 ml PCl <sub>3</sub>	25	17	0.76
OH, OCH <sub>3</sub> , piperidine	80 ml toluene	10 ml PCl <sub>3</sub>	50	17	0.75
OH, OCH <sub>3</sub> , piperidine	80 ml toluene	10 ml POCl <sub>3</sub>	25	17	0.62
OH, OCH <sub>3</sub> , piperidine	80 ml toluene	10 ml SOCl <sub>2</sub>	25	17	0.97
OH, OCH <sub>3</sub> , piperidine	80 ml toluene	10 ml SOCl <sub>2</sub>	110	15	1.02
OH, OCH <sub>3</sub> , piperidine	80 ml toluene	10 ml CH <sub>3</sub> COCl	25	17	0.39
OH, OCH <sub>3</sub> , piperidine	80 ml toluene	10 ml CH <sub>3</sub> COCl	50	17	1.03
OH, OCH <sub>3</sub> , piperidine	200 ml toluene	10 g PCl <sub>5</sub>	110	17	0.77
OH, OCH <sub>3</sub> , piperidine	120 ml CH <sub>2</sub> Cl <sub>2</sub>	10 g PCl <sub>5</sub>	25	17	1.22

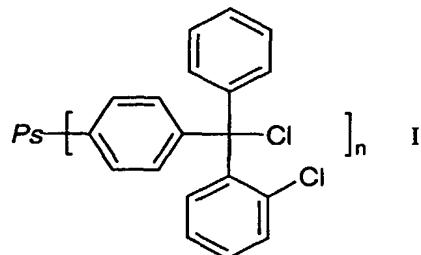
OH, OCH <sub>3</sub> , piperidine	80 ml CH <sub>2</sub> Cl <sub>2</sub>	10 ml SOCl <sub>2</sub>	40	65	0.97
OH, OCH <sub>3</sub> , piperidine	40 ml dioxane	9.8 g HCl (24.5 g/100 ml)	25	24	1.22
OH, OCH <sub>3</sub> , piperidine	50 ml dioxane	8.7 g HCl (17.4 g/100 ml)	25	24	1.29
OH, OCH <sub>3</sub> , piperidine	71 ml dioxane	11.1 g HCl (15.6 g/100 ml)	25	17	1.14
OH, OCH <sub>3</sub> , piperidine	90 ml dioxane	9.2 g HCl (10.2 g/100 ml)	25	24	1.21
OH, OCH <sub>3</sub> , piperidine	90 ml dioxane	14 g HCl (15.6 g/100 ml)	25	24	1.23
OH, OCH <sub>3</sub> , piperidine	90 ml dioxane	14 g HCl (15.6 g/100 ml)	10	24	1.23
OH, OCH <sub>3</sub> , piperidine	90 ml dioxane	14 g HCl (15.6 g/100 ml)	25	65	1.18
OH, OCH <sub>3</sub> , piperidine	2x 90 ml dioxane	2x 14 g HCl (15.6 g/100 ml)	25	2x 24	1.16
OH, OCH <sub>3</sub> , piperidine	90 ml dioxane (no pretreatment)	14 g HCl (15.6 g/100 ml)	25	20	1.21
OH, OCH <sub>3</sub> , piperidine	90 ml dioxane	24.3 g HCl (27 g/100 ml)	25	21	1.29

OH, OCH <sub>3</sub> , OC <sub>2</sub> H <sub>5</sub> , piperidine	90 ml dioxane	24.3 g HCl (27 g/100 ml)	25	20	1.27
OH, OCH <sub>3</sub> , i-OC <sub>3</sub> H <sub>7</sub>	90 ml dioxane	23 g HCl (25.5 g/100 ml)	25	22	1.31
OH	90 ml dioxane	18.9 g HCl (21 g/100 ml)	25	24	1.6
OH	90 ml THF	19.7 g HCl (21.9 g/100 ml)	25	18	0.99
OH	90 ml THF	31.1 g HCl (34.5 g/HCl)	25	24	1.15

From the data presented in Table 1 it is clear, that by carrying out the reaction according to the present invention the recovered 2-CTC resin achieved unexpectedly the content of active chloride before use.

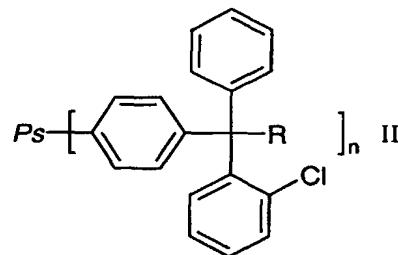
Claims

1. Process for the preparation of solid phase bonded 2-chlorotriyl chloride (2-CTC resin) of formula I



5 wherein Ps is a polymeric support and n has the following meaning:  $1 \geq n > 0$

comprising the reaction of solid phase bonded 2-chlorotriyl of formula II



wherein R is OH or/and  $OC_{1-4}$ -alkyl or/and  $NR'R''$

wherein  $R'$  and  $R''$  independently of each other represent  $C_{1-4}$ -alkyl, or  $R'$  and  $R''$  together  
10 with the nitrogen to which they are bonded represent a 5 to 8 membered heterocyclic  
radical

in the presence of a chlorinating agent and an organic solvent.

2. Process according to claim 1 wherein the organic solvent is toluene, chlorobenzene,  
15  $CH_2Cl_2$ , DMSO, NMP, DMF, alkylethers, DME, Diglyme, THF or dioxane.

3. Process according to claim 1 or 2 wherein the chlorinating agent is  $PCl_5$ ,  $PCl_3$ ,  $POCl_3$ ,  
 $SOCl_2$ ,  $CH_3COCl$ ,  $CO_2Cl_2$ ,  $(CH_3)_3SiCl$  or  $HCl$ .

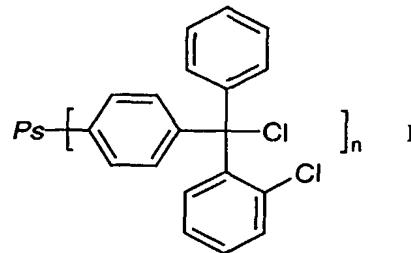
4. Process according to claims 1-3 wherein n has the following meaning:  $0.9 \geq n \geq 0.5$ .
5. Process according to claim 1-4 wherein the reaction temperature is between 0 and 5 110°C.
6. Process according to claim 1-5 wherein the HCl content in dioxane is about 0-20 g/100ml.
- 10 7. Process according to claim 1-6 wherein the reaction time is 6-96 h.

8. Process according to claim 1-7 wherein it is carried out in a single percolation or in repetitive percolations.

Abstract

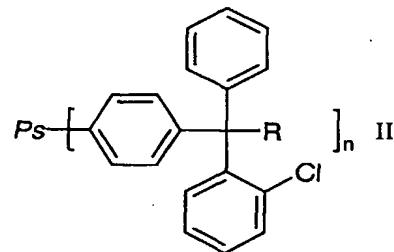
The present invention relates to a recycling process for the preparation of solid phase bonded 2-chlorotriyl chloride (2-CTC resin) useful for solid phase peptide synthesis.

Specifically what is claimed is a process for the preparation of solid phase bonded 2-chlorotriyl chloride (2-CTC resin) of formula I



wherein Ps is a polymeric support and n has the following meaning:  $1 \geq n > 0$

comprising the reaction of solid phase bonded 2-chlorotriyl of formula II



10 wherein R is OH or/and  $OC_{1-4}$ -alkyl or/and  $NR'R''$

wherein R' and R'' independently of each other represent  $C_{1-4}$ -alkyl, or R' and R'' together with the nitrogen to which they are bonded represent a 5 to 8 membered heterocyclic radical

in the presence of a chlorinating agent and an organic solvent.

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